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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/784,751	02/23/2004	Timothy Daniel Kostar	13DV-14085 (07783-0113)	2241

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EXAMINER	
MATZEK, MATTHEW D	
ART UNIT	**PAPER NUMBER**
1771	

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	04/18/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary	Application No.	Applicant(s)	
	10/784,751	KOSTAR ET AL.	
	Examiner	Art Unit	
	Matthew D. Matzek	1771	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *24 January 2007*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-20 and 28-31* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-20 and 28-31* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *23 February 2004* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

Response to Amendment

1. The amendment dated 1/24/2007 has been fully considered and entered into the Record. Claims 1 and 28 have been amended. The amended claims contain no new matter. Claims 1-20 and 28-31 are currently active.

Claim Rejections - 35 USC § 103

The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

2. Claims 1-18 and 28-31 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tani (US 2003/0145934) in view of Hillig et al. (US 4,917,941).

a. Tani teaches a process for producing a fiber-reinforced silicon carbide composite offering high toughness comprising a multiple layer laminate (Abstract). Woven, nonwoven and unidirectional prepregs of silicon carbide fiber are available to reinforce the silicon carbide matrix [0014, 0015]. The voids between the fibers of each layer of the composite are filled with polymeric resins and silicon. The matrix serves to impregnate or infiltrate the spaces between the fibers of the fabric support layers [0019 and 0020]. Following heat-treatment the two components form a porous silicon carbide matrix that link the fibers of each layer of the laminate (Abstract, 0006)]. The laminate of Example 3 comprises two layers of nonwoven and two layers of woven silicon carbide fabrics laminated in alternating order creating a laminate combination of nonwoven/woven/nonwoven/woven. Unidirectional fiber prepregs, which comprise continuous fibers, may replace the woven fabric layers [0014]. Replacing the woven fabric layers of Example 3 with unidirectional fiber prepreg layers creates a ceramic

matrix composite laminate with a nonwoven layer in between two layers of unidirectional fiber prepreg. The invention of Tani is silent as to the use of chopped ceramic fibers in the creation of the nonwoven fabric layer.

b. Hillig et al. teach a fiber and a filament containing ceramic preform comprised of a mixture of discontinuous fibers surrounding a layer of continuous filaments extending through the mixture. The mixture is produced by and infiltrated with a molten ceramic to produce a composite (Abstract). The continuous fibers provide reserve strength to the composite should it crack and the discontinuous fibers provide toughness to the composite (col. 1, line 61-col. 2, line 12). The discontinuous fibers may be chopped silicon carbide fibers or a mixture of different ceramic fibers (col. 3, lines 1-20). The continuous fibers may be made of silicon carbide or a mixture of different ceramic fibers (col. 5, lines 43-49). Hillig et al. also show that is it advantageous for the ceramic matrix to comprise at least 50 percent of the chopped fiber layer (col. 11, lines 10-14). Therefore, claims 12 and 13 are rejected.

c. The structure of the applied article has a layer containing a plurality of continuous ceramic filaments adjacent a layer of chopped ceramic fibers located in a continuous matrix phase which is adjacent another layer containing a plurality of continuous ceramic filaments (claim 5). A number of chemical species are available for use as the infiltrant to create the continuous matrix including ceramics (col. 4, lines 1-14). The continuous matrix phase is to be distributed evenly throughout the composite to create the instantly claimed infiltrated article (col. 11, lines 6-13). Claim 5 is rejected as the ceramic fibers may have a length of from about 10 to about 2000 microns (0.0004 to 0.08 inches) (col.

3, lines 13-15). Claim 14 is rejected as the ceramic chopped fibers have diameters up to 10 microns (0.0004 inches) (col. 3, lines 10-15).

a. Claims 8-11 are rejected as the matrix phase of the applied invention is designed to fill the space the between adjacent layers of continuous filaments thereby reducing the number of inter-laminar voids, size and volume fraction of said voids. The most preferred embodiment is a completely pore-free composite (col. 10, lines 61-64).

b. Since Tani and Hillig et al. are from the same field of endeavor (i.e. fiber-reinforced silicon carbide composites), the purpose disclosed by Hillig et al. would have been recognized in the pertinent art of Tani.

c. It would have been obvious at the time the invention was made to a person having ordinary skill in the art to have made the nonwoven layers of Tani with the chopped ceramic fibers of Hillig et al. and formed a composite without any remaining voids. The skilled artisan would have been motivated by the desire to provide the composite with toughness (col. 1, line 61-col. 2, line 12, Hillig et al.).

d. Claim 2 is rejected as Hillig et al. teach a chopped fiber mat thickness of 0.02" (Example 1). Tani and Hillig et al. disclose the claimed invention except for the nonwoven mat thickness of claim 3. It would have been obvious to one having ordinary skill in the art at the time the invention was made to have made a thinner nonwoven mat layer between 0.001 and 0.002 inches thick, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 105 USPQ 233. A thinner

nonwoven mat would allow for the stronger unidirectional fiber layers to make up more of the ceramic composite improving its total strength.

e. Claim 4 is rejected as the discontinuous fibers of the chopped fiber layer of Hillig et al. are randomly oriented and then infiltrated with ceramic matrix.

3. Claims 19 and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tani (US 2003/0145934) in view of Hillig et al. (US 4,917,941) as applied to claim 1 above, and further in view of Colegrove et al. (US 6,096,669). The inventions of Tani and Hillig et al. are silent as to the use of multiple layers between the continuous fiber perform lamina.

a. Colegrove et al. teach a preform suitable for use in creating a composite laminate (Abstract). Figure 5 shows an embodiment of the perform comprising a nonwoven layer **20**, resin **8**, and unidirectional fiber layer **10**. The unidirectional fibers may be silicon carbide (col. 4, lines 24-26) and the nonwoven mat may be made of chopped silicon carbide fibers (col. 4, lines 52-55). Multiple plies of the Colegrove et al. invention may be laminated together (col. 5, lines 49-53). The lamination of two preforms of Figure 5 with the nonwoven layers **20** would result in a symmetric article with two nonwoven layer adjacent layers of resin **8**, and adjacent two layers of unidirectional layers **10**.

b. Since Tani and Colegrove et al. are from the same field of endeavor (i.e. silicon carbide fiber composites), the purpose disclosed by Colegrove et al. would have been recognized in the pertinent art of Tani.

c. It would have been obvious at the time the invention was made to a person having ordinary skill in the art to modify the article of Tani and Hillig et al. to include multiple layers of the nonwoven mat of Tani between the layers of directional continuous ceramic

fibers. The skilled artisan would have been motivated by the desire to create an article that possesses enhanced thermal properties with the inclusion of additional chopped silicon carbide fibers. The enhanced thermal property allows the composite to have a more uniform thermal expansion, thereby decreasing the thermal stresses that buildup due to mismatched coefficient of thermal expansions between its phases.

Response to Arguments

4. Applicant's arguments filed 1/24/2007 have been fully considered but they are not persuasive.

5. Applicant argues that the Hillig et al. reference fails to properly provide Tani with a teaching of using chopped ceramic fibers. Applicant asserts that Hillig et al. are not concerned with forming a mass of ceramic fibers to be carbonized and impregnated. The mass of Hillig et al. is dried and then impregnated to form the desired composite. The chopped fibers of Hillig et al. are used to solve a different problem than as found in Tani and the combination would change the principle or operation of the prior art invention of Tani. In Tani, the fibrous reinforcement serves to provide the composite with high toughness even if the final product is to have a complicated shape. The chopped fibers (whiskers) of Hillig et al. are specifically directed to providing the same function of providing the matrix layer with toughness (col. 1, line 61-col. 2, line 12). Therefore, the combination would not change the principle or operation of the prior art invention of Tani.

6. Applicant argues that Hillig et al. laminates his chopped fibers between filaments that are not preforms, but are individual strands. Thus, one of ordinary skill in the art would not look to Hillig et al. to solve Tani's deficiency of the lack of using chopped fibers. As stated in the

previous response to Applicant's argument, the chopped fibers of Hillig et al. are specifically directed to improving the toughness of the ceramic composite. This is a primary concern Tani. Therefore, one of ordinary skill in the art would have looked to Hillig et al. to modify the invention of Tani.

7. Applicant argues that the chopped fibers of Hillig et al. are never prepregs to be laminated as in Tani, thus one would not expect the chopped fibers of Hillig et al. to work with a reasonable degree of success in the invention of Tani. The fibrous layers of Tani are impregnated with matrix material following their formation. The layers of Tani are not simply arranged and then converted into a fibrous reinforced ceramic composite. Therefore, it would be reasonable to have made a nonwoven layer of Tani with chopped fibers and then impregnated said nonwoven layer with matrix material expecting a reasonable degree of success. In fact, the use of smaller and shorter fibers would improve Tani's primary goal of forming complicated shapes. Chopped fibers assist in attaining this goal by being able to conform to shapes that larger continuous fibers would not be able to successfully create.

8. Applicant argues that even if the chopped fibers of Hillig et al. are used to form a nonwoven prepreg in Tani, the combination fails to teach or suggest the limitation of "the nonwoven mat being interposed between adjacent preformed continuous fiber lamina of the plurality of preform lamina to form an interface between the continuous fiber lamina which reduces voids and prevents a continuous, stratified matrix rich layer between adjacent continuous fiber preform lamina". Tani teaches the creation of a dense fiber-reinforced silicon carbide composite [0009] and the matrix is used to impregnate the fabric reinforcement [0014]. This would lead one of ordinary skill in the art to recognize that there is no stratified matrix layer

between adjacent continuous fiber preform lamina rather that the matrix is predominantly located within the pores of the fabric [0019] and not forming a continuous matrix layer.

9. Applicant argues that even if the chopped fibers of Hillig et al. are used to form a nonwoven prepreg in Tani, the combination fails to teach or suggest the limitation of "the ceramic material filling the void spaces being substantially free of voids and substantially free of continuous, stratified matrix rich layer between adjacent continuous fiber preform lamina". As pointed out in the previous paragraph the matrix layer of Tani fills the voids of the fabric reinforcement layers and does not form a stratified matrix rich layer between adjacent continuous fiber preform lamina. The article of Tani is referred to as a dense composite on several occasions and the examples demonstrate that the composite is substantially free of voids.

10. Applicant argues that Hillig et al. does not teach or suggest a mat as recited by the instant independent claims. Applicant continues by asserting that simply substituting the chopped fibers of Hillig et al. into the teaching of Tani for the nonwoven fabric does not result in a mat. In the rejection set forth supra, Examiner has simply substituted the chopped fibers of Hillig et al. into the teaching of Tani. Examiner takes the position that my making a nonwoven fabric out of chopped fibers does in fact constitute a mat, because the chopped fibers would be commingled tangled mass of chopped fibers.

Conclusion

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO

MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew D. Matzek whose telephone number is 571.272.2423. The examiner can normally be reached on M-F, 9-5:30.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Terrel Morris can be reached on 571.272.1478. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

mdm MDM

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